SCIENCE

NEW YORK, APRIL 10, 1891.

MALARIA AND THE CAUSATION OF INTERMITTENT FEVER.[1]

DR. TOMMASI-CRUDELI and others have claimed that intermittent fever is caused by a bacillus.

Drs. Laveran, Osler, Council, and others have proved, to their own satisfaction at least, that intermittent fever is caused by a microscopic hæmatozoön.

At the meeting of the American Medical Association in Cincinnati, in May, 1888, I presented what I then considered, and still consider, to be incontrovertible evidence that intermittent fever is caused by exposure to changes of atmospheric temperature; that ordinarily its causation is quantitatively related to, and apparently controlled by, the range of atmospheric temperature.[2] It seems to me that both these lines of evidence, which appear to be so divergent, may be true. I feel sure that my own line is; and I have very great confidence in those who have presented the other line of evidence in which they are expert.

Therefore, although those who have held the germ theory of the causation of intermittent fever have not, so far as I know, accepted the evidence which I have collected and published, yet I feel impelled to again ask attention to it. I attempt this the more readily, because the facts and considerations, which it seems to me to make it appear possible that both lines of evidence may be true, were, in the main, held in mind when I read my paper two years ago; but there was not then time to elaborate, and I therefore only referred to, but did not fully state them.

I suppose that all here are probably familiar with the literature of the subject of the bacillus of malaria, and also that relative to the hæmatozoön of malaria, discovered by Laveran. I may therefore devote my time exclusively to that other phase of the subject on which I have collected evidence, and which is probably little known.

The most important evidence which has been presented by myself is as follows: —

1. Statistics of sickness from intermittent fever in Michigan during a long series of years, arranged to show the relation of intermittent fever to changes in atmospheric conditions, and which have proved to my mind that the controlling condition is associated with atmospheric temperature, the sickness rising and falling with the temperature.

2. Statistics relative to intermittent fever in the United States armies, elaborated from the medical and surgical history of the war of 1861–65.

An abstract of a summary of conclusions, based upon the evidence which I collected, is as follows: —

"2. The controlling cause of intermittent fever is exposure to insidious changes, or changes to which one is unaccustomed, in the atmospheric temperature.

"3. In the mechanism of the causation of intermittent fever, the chief factor is the delay in re-action from exposure to cool air. This delay, extending to a time when greater heat-loss should occur, results in the abnormal accumulation of heat in the interior of the body, and in disturbed nervous action,— the chill; and the final re-action is excessive, because of the accumulation of heat, and sometimes because it occurs at the warmest part of the day.

"4. The fever is the excessive re-action from the insidious influence of the exposure to cool air; and it is periodical because of the periodicity of nervous action, and, because the exposure and the consequent chill are periodical, owing to the nightly absence of the warmth from the sun.

"5. Residence in valleys or low lands through which or upon which cold air flows at night, and thus causes insidious changes in the atmospheric temperature, favors intermittent fever.

"6 In our climate, those measures, such as drainage, which enable the soil to retain warmth during the night, and thus reduce the daily range of temperature immediately over such soil, tend to decrease intermittent fever among residents thereon.

"7. In the cure and prophylaxis of intermittent fever, those remedies are useful which lessen torpidity and tend to increase the power of the body to re-act promptly to insidious changes in atmospheric temperature."

Preparing, now, to forge a link, in the chain of evidence, which was omitted from my paper, Sir William Moore, who has had great experience and observation in India, says, "So-called malarious fevers are caused by sudden abstraction of heat, or chill, under the influence of cold, and more especially of damp cold. These effects of chill are more marked in hot climates, because of the antecedent exposure to great solar heat, the anæmia and skin debility resulting from heat and the disregard of suitable precautions."

I think that my statistics indicate that another reason for there being most intermittent fever in hot climates is because the difference between the day and the night temperatures is the greatest in hot climates, and consequently the demands upon and resulting disturbances of the heat-regulating apparatus of the body are greatest in hot climates.

Intermittent fever is most prevalent in hot climates. In temperate climates, intermittent fever is most prevalent in the warm months. Here a reason similar to that just given applies,— it is then that there is greatest difference between the day and the night temperatures.

I believe that perspiration is probably a factor in the causation of intermittent fever. I do not base this opinion merely upon the facts just stated, relative to place and time of greatest prevalence, but mainly upon two facts, as follows: perspiration tends to cause chill, because of the fact that evaporation from moist clothing tends to lower the temperature rapidly. I believe that a chill, especially at the warmest time of the day, is not infrequently sufficient to start the disease intermittent fever. Excessive perspiration tends to change the condition of the blood; and chill tends to change the condition of the blood in some such way as follows: when the surface of the body is strongly contracted, the blood is driven from all the surfaces; the circulation is impeded; the blood parts with some of its fluid, and with it the salts, which pass into the urine; then there comes a demand of the tissues for blood; thirst is great, which, when satisfied, again fills up the blood-vessels. This rapid changing of the proportion of fluid in the blood tends, I believe, toward the solution or breaking-up of the red-blood corpuscles My belief is that the destruction of the red corpuscles is greater than it would be if only the proportion of water in the blood was changed; that the destruction occurs partly through a disturbance of the proportion of certain salts in the blood. It is not difficult to see how this may be. Excessive perspiration takes out salts, especially sodium chloride, in considerable quantity; the urine passes out salts in considerable quantity. On the other hand, the water drank to quench the thirst does not ordinarily take salts into the blood, except in cases where common salt is given as a remedy, which is sometimes done by non-professional persons. According to experiments made many years ago, in the circulating blood, in health, the red corpuscles are preserved by sodium chloride from being dissolved in the albumen. As this paper is not an exhaustive treatise on this sub-

[1] Abstract of a paper read at the forty-first annual meeting of the American Medical Association at Nashville, Tenn., May, 1890, by Henry B. Baker, M.D., of Lansing, Mich.

[2] "Malaria and the Causation of Periodic Fever" (Journal of the American Medical Association, Nov. 10, 1888).

ject, but is intended to be suggestive to other investigators. I do not now attempt to collate recent evidence on the changes in the blood. In order, however, to account for the destruction of the red corpuscles, the formation of the pigment, and for the phenomena of intermittent fever, I see no need for the micro-organism which is alleged to be parasitic in the blood, in intermittent fever. It seems to me that all of the phenomena can be accounted for about as well without the parasites as with; but it seems to be a general fact in nature, that, whenever a highly organized being commences to break down, there are generally organisms that await the occurrence; and, when the breaking-down process is of elements microscopic in size, I believe that micro-organisms are generally there. I accept the evidence of the eminent men who have reported that they are present in the blood in intermittent fever.

But if we grant that malarial fever is caused by micro-organisms parasitic in the blood, it has remained to be explained how it is that the micro organisms only cause intermittent fever under certain conditions of the atmosphere. That intermittent fever does occur under some conditions, and does not occur under other conditions, has long been positively known. I claim that the statistics which I have collected prove what those conditions are, and that the relation of those conditions to intermittent fever is quantitative and causal. I refer more especially to the evidence relative to the half million and more cases of intermittent fever which occurred in the United States armies during the war in 1862–64, and to the evidence of the recorded experience of physicians in Michigan during eight years.[1]

[1] Diagrams and statistics were given by Dr. Baker in support of his position.

HEALTH MATTERS.

Ether-Drinking.

MR. ERNEST HART, editor of the *British Medical Journal*, has lately published some statistics and important information relative to the above subject. The matter is of very great value, directly and indirectly, says Henry Conkling, M.D., in *The Brooklyn Medical Journal* for April. It calls attention to the internal use of a remedy which, as a powerful cardiac stimulant, has been used but little of late. The published statistics have been collected, in part personally, and also by communication with medical men, clergymen, and others in the various parts of Ireland where the custom prevails.

The earliest history of the habit goes back to 1842 The greatest amount of ether used for drinking-purposes was in 1876. A few years after this date there was a diminution in the consumption; but it has since increased, until at the present time the amount nearly equals that of 1876. The majority of the ether (methylated ether) comes from large English houses, being sent sometimes to wholesale Irish firms, who retail it, or directly to the smaller dealers. It is put up in stoppered bottles or metal vessels. It is sold to the consumers in groceries, taverns, and public-houses, selling for two cents (United States money) for two drams. Its very small cost enables the dose to be frequently repeated. From two drams to half an ounce is the amount usually drunk; and this is repeated from two to six times during the day, depending on the personal habits. One or two cases of confirmed drinkers are mentioned where one pint of ether was generally used, when on a debauch, in divided doses.

The amount that produces intoxication depends on the individual. The ether is drunk in a single swallow, sometimes diluted, and again taken pure. The intoxicating effects are quickly produced, and quickly pass away. It is possible, therefore, as the author observes, for an *habitué* to become intoxicated many times in a short period.

A small dose causes a feeling of exhilaration, the drinker laughing, dancing, and being quite wild in his movements. If the small dose be not exceeded, there is no period of marked depression following the stimulation; but in larger quantities a state of stupor is frequently present, and, as the effect passes away, a feeling of weakness is left.

It will be seen, in reading the individual accounts given in the paper, that mania is a marked feature very commonly presented, the drinkers often becoming very violent.

In moderate amounts, no lesions anatomical in their nature are produced. Of the two intoxicants alcohol and ether, the former probably causes more bodily derangement.

In ether-drinkers who have continuously consumed large quantities, a train of nervous and circulatory disturbances is generally present. Emaciation has been observed in certain cases, and occasionally the skin is of a cyanotic hue. The more moderate drinkers generally suffer from various forms of stomach troubles. In all cases there has been observed a marked change, in the way of deterioration, in the moral character.

The relation of ether to insanity was also investigated. No satisfactory evidence of the drug being directly causative could be gathered, but physicians to certain of the insane-asylums regarded it as detrimental in all cases where there was latent insanity. Death is probably not hastened in any great degree, although, by interfering with nutrition, the general health may become impaired.

Attention is called to the fact that there is danger to the user from having the drug near the fire or lights of any kind. The author believes that the practice probably prevails in certain parts of large cities.

It is interesting to observe how common the use of ether as an intoxicant must be, in the districts investigated, when the public conveyances are frequently impregnated with its odor.

This curious and novel paper teaches one valuable therapeutic lesson: the effect of the drug has been shown to be rapid and transient. In its use, therefore, as a cardiac stimulant, this point should be recollected, and no long intervals should go between the time of giving the various doses. Its rapid action makes ether a safe and valuable remedy for hypodermic use in conditions of syncope.

Poisonous Mussels.

A case of fatal poisoning of a mother and four children from poisonous mussels is reported by Sir Charles A. Cameron, M.D., in the *British Medical Journal* for July 19, 1890, and republished in *The Brooklyn Medical Journal* for April.

The first symptoms came on in twenty minutes after eating the stewed mussels. These were a prickly ("pins and needles") pain in the hands. Five persons ate of the dish, one lightly; and in one hour afterward one of the children died, and an hour later the mother and three other children. One child and the servant recovered.

The chief symptoms were vomiting, dyspnœa, swelling of the face, loss of co ordination of movements, and convulsions. The patients died asphyxiated. The mussels were fresh, and were obtained from a pond which was a mixed salt and fresh water pond, and received some sewage. The mussels, on examination, were found to have large livers and brittle shells. A leucomaine was extracted from the liver of the mussels which resembles Brieger's mytilotoxine ($C_6H_5NO_2$). The liver seemed to be the seat of the poison, which had been before noticed by M. Dutertre of France. The cause of this peculiar disease, the author thinks, is due to the foul water in which the mussels lived.

The livers of these mussels were examined microscopically by Dr. McWeeney, and in a preliminary note published in the *British Medical Journal* of Sept. 13 he describes at least five different organisms appearing in his cultures, one of which, he thinks, is the specific organism of the poison.

The important lesson is, that mussels from stagnant or sewage-laden waters should not be eaten.

Influenza in the German Army.

The medical department of the Prussian War Office has furnished statistics of the epidemic of influenza from the medical records of the German Army, an extract from which is given in *The Boston Medical and Surgical Journal* for March 26. The name "grippe" is supposed to be derived from the Polish word "chrypka," which means catarrh. The epidemic appeared in the army suddenly at the end of November, 1889, and in March was

considered as entirely passed. The first cases occurred in the barracks situated in the Baltic provinces, from which place it spread rapidly, the larger garrisons being generally attacked first. There was, roughly speaking, a belt stretching across the country from north-east to south west, in which belt the epidemic seemed to travel, and outside of which the cases were less frequent and severe. A number of garrisons at a distance from this path, that is, in the south-east and north-west, escaped altogether. The time occupied in spreading through the whole army was five weeks, whereas the epidemic of the year 1833 took more than three months. The total number of cases reported was 55,263, of which three-tenths of one per cent were seriously ill, and one-tenth of one per cent died. The Bavarian troops suffered the most. The larger number of cases occurred among the younger men, and the smallest number among the artisans. Many other interesting data are recorded.

Hæmolymph Glands.

It might be thought, that, after the careful search that has been made in all the tissues of the animal body, it would be almost impossible to find a structure that has up to the present remained undescribed; yet Mr. W. F. Robertson, working under Dr. William Russell, in giving a careful histological description of his so-called hæmolymph glands, has opened up a new field for histological and pathological research. From the description given, says the *Lancet*, the hæmolymph glands appear to be a kind of cross between the spleen and the lymphatic glands, as almost all the structures that Mr. Robertson describes may be found in one or other of these organs, although they have never yet been figured as he finds them arranged. Most observers who have noted the existence of the small prevertebral blood-red points have assumed that they were simply lymphatic glands, the cortical spaces of which were distended with blood ; and, although every butcher can point them out, it appears that no one has hitherto had sufficient curiosity to determine him to examine these structures microscopically. The large cells, with their colorless subdivided nuclei found in the sinuses, appear to be somewhat similar in character to the large red-blood corpuscle-forming cells that have been described in the spleen, and even free in the blood circulation, and it will be interesting to note whether it is possible to make out any relation between the cells in the blood and those in the hæmolymph glands. Although at first sight it might appear that Mr. Robertson's observations may lead to further complications in the study of the blood-forming and blood-destroying functions, it is hoped that a careful study of the structures that he has so well described may allow of further light being thrown on these subjects. We are gradually drifting further and further away from the idea that special functions are necessarily bound up in special organs. That there is a special development in certain kinds of tissue in special organs, and consequently that certain functions are here carried on more actively, all will admit; but we are gradually coming to see that such functions as the glycogenic, hæmogenic, and the zymogenic are carried on in every part of the body, and that the various differences as regards these functions in the various tissues are those of degree rather than those of kind.

Dietetic Employment of Fat.

W. Zuntz has a paper on the dietetic employment of fat in the *Therapeutische Monatshefte*, October, 1890, an abstract of which appears in the *Medical and Surgical Reporter*. He was induced to put to the experimental test of some conditions of digestion of fat a preparation of chocolate suggested by Von Mering. The chocolate is so made that it possesses a sufficient quantity of free fatty acids to form a permanent emulsion without in any way injuring the taste of the chocolate. In order to find out whether the digestibility of fat is enhanced by the power to form an emulsion Zuntz sought to find out what quantity of cacao-butter, with and without the addition of fatty acids, was appropriated when administered to dogs. The result was, that there was an increase in digestibility, which was only slight,— two per thousand of the fat,— if moderate quantities of cacao-butter were cooked with the rest of the food, but it was considerable if (as is usually the case with cod-liver oil, in order to avoid stomach digestion) the cacao-butter was given some time before the rest of the food, and in somewhat greater quantities. In the latter case there appeared in the stool 9.9 per cent of pure cacao-butter, and only 6.1 per cent of the emulsionized.

Corresponding to the result of the emulsionizable cacao-butter in dogs, the fat of Mering's chocolate proved to be very digestible in men. For three days a moderate diet poor in fat, consisting of bread and lean meat, was given, and in addition a daily quantity of 416 grams of chocolate containing 87 grams of fat. In the fæces appeared only 4.88 per cent of fat; whereas Weigmann, in a series of experiments with ordinary cacao-butter, administering 53 grams, recovered 5.5 per cent. In comparison with the most used fats, and those fats prized on account of their being easily digestible, such as butter, lard, marrow, the fat of the chocolate preparation is seen to be considerably superior.

Eating before Sleeping.

A recent writer, says the *Journal of the American Medical Association*, states that the view that brain workers should go supperless to bed is not good advice. Most medical authorities of the day think it wrong. It is a fruitful source of insomnia and neurasthenia (sleeplessness and nervous prostration). The brain becomes exhausted by its evening work, and demands rest and refreshment of its wasted tissues, not by indigestible salads and "fried abominations," but by some nutritious, easily digested and assimilated articles. A bowl of stale bread and milk, of rice, or some other farinaceous food, with milk or hot soup, would be more to the purpose. Any of these would insure a sound night's sleep, from which the man would awaken refreshed.

New Medicinal Soaps.

The *Edinburgh Medical Journal*, February, 1891, says that Eichhoff of Elberfield, who has already added to the list of medicinal soaps some of real value, and embodying some valuable improvements, has continued his researches into the subject. He reviews the conditions of the skin in which soap treatment is to be recommended. This is specially indicated in cases where the skin is unctuous. The soap removes the excess of fat, while the incorporated drug, if suitably chosen, acts at the same time on the disease itself, and, as Eichhoff thinks, can chase the offending organisms from the ducts of the cutaneous glands. He quotes in support of this the treatment by medicinal soaps of psoriasis, which he regards as parasitic, and of acne, the pustules in which are now believed to be due to the pyogenic micrococci. He praises also the cleanliness, the innocuousness, and the cheapness of this method with the vigor of a true partisan.

Soaps may be, for convenience, divided into (1) alkaline, containing an excess of free alkali; (2) neutral, in which all the alkali is combined with the fatty acids; (3) so-called acid soaps, which are prepared either by the addition of weak acids or by being superfatted, and eventually re-act faintly acid. The alkaline may be used to remove masses of scales; while in acute inflammations of the skin, or when it is irritable, the neutral or superfatted soaps are to be employed. The superfatting of the new soaps consists of 2 per cent lanoline, and 3 per cent olive oil, and they are made by Ferdinand Mühlens at Cologne. Among these new soaps may be specially mentioned a menthol soap, containing 5 per cent of menthol. The local anæsthetic influence of menthol on the skin is well known, and the principal use of this soap will probably be found in lessening pruritus. Eichhoff cites some cases where cure resulted in pruritus senilis and pruritus genitalium. He recommends, that, should the soap be employed for the head or lace, the eyes should be kept firmly shut, else an unpleasant, though, he says, not dangerous, coldness of the conjunctiva is perceived. A 5-per-cent salol soap is one which may prove useful in psoriasis. The salol, when so used with water, breaks up into carbolic and salicylic acids, and these in their nascent condition may be expected to act with energy. A 5-per-cent resorcin soap promises to be of advantage in cases where this valuable drug is indicated.

NOTES AND NEWS.

THE excursion committee of the Appalachian Mountain Club, Boston, presents the following preliminary programme for the 1891 excursions, subject to possible changes: Saturday, April 18, mayflower walk, Marshfield; May 9, May walk, Andover, Mass.; May 30, Mount Wachusett; June 17, laurel excursion to either Milford or Mount Vernon, N.H.; about July 1, field meeting at the Catskill Mountains, N.Y.; Monday, Sept. 7 (Labor Day), Bristol, N.H. It is hoped that a camping party to Moosehead Lake may be arranged in August. Members who desire to join the party are requested to notify the chairman of the special committee before July 25. The autumn excursion may possibly be to Mount Chocorua the latter part of September.

— Bulletin No. 72 of the Michigan Agricultural Experiment Station is by W. J. Beal, and is entitled "Six Worst Weeds." Mr. Beal states that some of our most troublesome weeds are natives of the neighborhoods in which they are found, but most of them have been introduced from other portions of our own country or from foreign countries. The seeds of most weeds find their way on to a farm nicely mixed with seeds of grasses, grains, and clovers, which are drilled in or sowed broadcast on fertile soil, where they are afforded an excellent opportunity to grow and multiply. In some instances weeds are introduced as a part of the packing or straw employed to protect castings, marble, crockery, or fruit-trees. Such foreign packing should always be burned at once. By these processes above noticed, the older the country, the more troublesome weeds it will have, as every new intruder usually comes to stay. In most cases a weed becomes well established before it is discovered; and the inquiry comes, "What is it, and how can I get rid of it?" Enclosed in the bulletin were samples of seeds of six sorts which have a bad reputation, and it will be best to watch them. Most of them are already pretty well known by some of our farmers. They are not indigenous, but have all been introduced from Europe. The following rules are worth observing: 1. Carefully examine seeds before sowing, and see that they are clean, and thus prevent the introduction of weeds; 2. Keep a sharp lookout, and exterminate the few first intruders before they spread themselves; 3. Usually, as in all the six cases referred to, perhaps excepting the Canada thistle, one or more so-called hoed crops, like corn, potatoes, or beans, most thoroughly tended throughout a single growing season, or for two seasons in succession, will be a good practice. There is no royal way in which to kill weeds.

— To find a paint of lasting qualities, which will prevent the corrosion of iron due to atmospheric agencies, is a problem with which engineers have dealt earnestly for many years. Until within quite recent years, little has been known in this country of the valuable properties of asphalt, and to many they are still unknown. In the popular mind it is often confused with certain coal-tar products, which, though similar in appearance, differ essentially from asphalt in character. Asphalt oils are of a non-volatile nature, and are therefore permanent, while, on the other hand, coal-tar and linseed oils are volatile, and therefore non-permanent. Herein lies the secret of the paint problem, says *The Railroad and Engineering Journal* for April. In order to prevent rust, some substance must be used as a coating for the iron which is impervious to air and moisture; and it is of equal importance, that it may remain impervious, that it should be unaffected by the heat of the sun and by exposure to the air. It is claimed that there is no other substance in nature which so nearly complies with these severe requirements as asphalt. The so-called asphalt paints which have been commonly used in the past are such only in name. They contain, at best, but a very small per cent of asphalt, which is incorporated in the form of a pigment, and which serves no valuable purpose. Asphalt, on the contrary, should be the main constituent, since the virtue of such a paint depends upon the presence of the permanent asphalt oils. When these so-called asphalt paints are made in light colors, durability becomes subservient to ornamentation. The virtues sought in asphalt are lost by substituting for it the necessarily large quantity of light-colored pigment essential in counteracting the natural dark color of the asphalt.

— The question of the use of special fertilizers under glass is becoming one of great importance, and is attracting much attention among practical gardeners and scientific men. Even the best and most skilled gardeners sometimes find that their soil, made up after the best formulas, fails to give the results expected. The plant-food seems to be unavailable, or the plant lacks the vigor to make use of it, and something more active is needed to give it a start. To determine what special fertilizers will give the best results applied to crops under glass, a series of experiments were started in the winter of 1888–89, at the Massachusetts Agricultural College, under the direction of Samuel T. Maynard of the Division of Horticulture, the results of which are deemed of sufficient value for publication, although a longer series of tests may somewhat modify the results thus far obtained. In it was found, that, of the nitrates, the nitrate of potash gave the best results, but that the sulphate of ammonia gave better results than either, especially in the production of a foliage crop Of the potash salts, the sulphates gave better results than the muriate. Bone-black showed a marked effect in increasing the number of blossoms.

— The director of the Connecticut Agricultural Experiment Station, New Haven, Conn, calls the attention of dairymen to a method of determining fat in milk devised by Dr. Babcock of the Wisconsin Station. Its merits are, that it is rapid; that both the milk and the fat are measured, so that all weighing is dispensed with; and that it is very accurate. It furnishes, he thinks, the most rapid and accurate means of testing milk of individual cows or herds. The apparatus is in daily use at the station. Twenty-three cows are under experiment, and separate fat determinations are made daily in the morning and night milk of each cow; the whole, including the cleaning of the apparatus, being accomplished in two hours by two persons. A considerable saving of time will be secured when power is used for driving the centrifuge. With this aid, a young man or woman could probably do the whole easily in from three to four hours.

— A correspondent of the *Pall Mall Gazette* writes, "I recently witnessed the following little incident on the Thames, near Twickenham, when the river was full of land-water, and therefore very swift and dangerous. Two dogs — one a large animal, the other a little terrier — were enjoying a swim near the bank, but soon the little one was carried out some distance, and was unable to get to shore. By this time the big dog had regained the shore, and, seeing what was happening to his companion, began running backwards and forwards in the most excited manner, at the same time whimpering and barking, and evidently not knowing for the moment what to do. The terrier was fast losing strength, and, although swimming hard, was being rapidly carried down stream. The big dog could contain himself no longer. Running some yards ahead of his struggling friend, he plunged into the water and swam vigorously straight out until he got in a line with the little head just appearing behind him. Then he allowed himself to be carried down, tail first, until he got next to the terrier, this being accomplished in the cleverest manner, and began to swim hard, gradually pushing the little one nearer and nearer to the shore, which was gained after a most exciting time. The fact of this canine hero going so far ahead to allow for the strong current, and the judgment shown in getting alongside, and then the pushing, certainly seemed to me to betoken instinct of a very high order."

— An important communication upon the color and absorption spectrum of liquefied oxygen is made by M. Olszewski to a German periodical, and a brief abstract is published in *Nature* of March 26. Liquid oxygen has hitherto been described as a colorless liquid. In thin layers it certainly appears to be colorless; but M. Olszewski, in the course of his investigation of the absorption spectrum, has obtained a sufficient quantity of the liquid to form a layer thirty millimetres thick, and makes the somewhat unexpected and very important discovery that it possesses a bright blue color resembling that of the sky. Great precautions were taken to insure the purity of the oxygen employed, the absence of ozone, which in the liquid state possesses a deep-blue color, being especially ascertained. Carbon dioxide, chlorine, and water-vapor

were also completely eliminated, the oxygen having been left in contact under pressure with solid caustic potash for a week. In view of this fact, that oxygen in the liquid state transmits a preponderating quantity of blue light, M. Olszewski's latest experiments upon its absorption spectrum are specially interesting. In a former paper to the *Monatshefte*, an account of which was given in *Nature*, the absorption spectrum of a layer 7 millimetres thick was shown to exhibit two strong dark bands,— one in the orange, extending from wave-length 634 to wave-length 622, distinguished for its breadth; and one in the yellow, wave-length 581–573, distinguished for its intensity. When the thickness of the layer was increased to 12 millimetres, two further bands appeared, — a very faint one in the green, about wave-length 535, and a somewhat stronger one in the blue, extending between wave-lengths 481 and 478. M. Olszewski now finds that his layer 30 millimetres thick, which possesses the blue color, exhibits a fifth band in the red, corresponding with Fraunhofer's A. This band is rendered still more apparent when a plate of red glass is held between the source of light and the slit of the spectroscope. It is stronger in intensity than the band of wave-length 535, but fainter than the other three bands. This observation of the coincidence of an oxygen band with the telluric band A of the solar spectrum is of considerable interest: for Angström, in 1864. expressed the opinion that this band A was not due to the aqueous vapor of the atmosphere; and Egoroff and Janssen, who examined the spectrum of long layers of compressed gaseous oxygen, were of opinion that it was due to oxygen. In conclusion, M. Olszewski remarks that the color exhibited by his 30-millimetre layer is exactly what one would expect from the nature of its absorption spectrum. He also suggests that the blue color of the sky may be simply due to the atmospheric oxygen, which in gaseous layers of such extent may exhibit the same color as when compressed into a few centimetres of liquid. Apart from the discussion of this debatable subject, the fact is certainly of interest to chemists, that ordinary oxygen and its condensation allotrope ozone, when compressed into the liquid state, are thus related as regards color, the former possessing a bright blue and the latter a deep blue tint.

— Professor Elihu Thomson, according to *Engineering* of March 27, has recently completed some very remarkable experiments on the physiological effects of alternate currents. He finds that the danger of the current diminishes as the number of alternations per second is increased. Thus it took twenty times as strong a current to kill a dog when the alternations were 4,500 per second as when they were 120 per second. When the alternations were 300 per second, the current was only half as dangerous to life as when the alternations were 120.

— Traffic in the Suez Canal continues to expand, and now the gross tonnage of vessels using it is about ten millions, and it is interesting to note that Britain continues to own a preponderating proportion of that tonnage. Last year, according to *Engineering*, 3,389 vessels traversed the canal, and, curiously enough, the numbers were practically equally divided between outward and homeward vessels. At the Port Said entrance 1,694 vessels passed in, while 1,695 entered the canal at Suez. This total has thrice been exceeded. In 1885 the maximum was reached at 3,624 vessels, and has not been equalled; while in 1888 the number was 3,440, and in 1889, 3,425 vessels. The tonnage, however, shows a steady expansion. It is well known that the average size of English sea-going steamers is increasing, and this is satisfactory for the canal authorities. It does not affect the dues paid for transit, and admits of a larger tonnage passing within a given time. It is found, for instance, that while the number of vessels passing in 1885 was 240 more than in the past year, the tonnage now is nearly half a million greater : in other words, the average size of vessels in 1885 was about 1,750 tons, and it is now over 2,000 tons. The transit receipts show clearly the growing popularity of the canal route to the East. In 1869, the first year of the canal, the receipts totalled only £2,076; in the year following they were £200,000; in 1872 they reached £656,300, and five years later this sum was more than doubled. Between 1880 and 1882 there was a great forward movement, the total being increased to £2,421,832. Since then the progress has been neither so steady nor so great But during the past three years the upward movement has continued, the total last year being £2,680,436. Of the total tonnage, Britain owns nearly 78 per cent. There has been a great development in the number of vessels using the canal at night, and navigating by the electric light. Of the total number passing through the canal last year, 2,836 went at night, or 48 per cent. The number per month varied from 276 in December last, to 209 in August. In 1887 the night passages were 395, or 12.6 per cent of the total; in 1888, 1,611, or 47 per cent; in 1889, 2,445, or 71.5 per cent. According to Consul Burrell, from whose report to the foreign office these figures have been taken, the average time of transit has been reduced to 24 hours 6 minutes, against 25 hours 50 minutes in 1889, 31 hours 15 minutes in 1888, and 36 hours in 1886. By night with electricity the passage takes a shorter time than by day, the average last year being 22 hours 9 minutes; in 1889, 22 hours 30 minutes; in 1890, 22 hours 34 minutes. The shortest passage last year was 14 hours 15 minutes by electric light, and the fastest on record. For the transit with electric light the great majority of the vessels obtain the apparatus from different shipping agents at a uniform rate of £10 for the transit.

— We learn from *Engineering* that in a lecture delivered before the students of Sibley College, Mr. O. Chanute, president of the American Society of Civil Engineers, dealt with the question of aërial navigation. Reasoning from the results obtained by Capt. Renard with "La France," he concludes that with a balloon 330 feet long, with a maximum diameter of 55 feet, a speed of from twenty-five to thirty miles an hour might be attained. Mr. Chanute thinks, however, that the problem of flight is more likely to be solved by means of the aëroplane than with the balloon. To obtain a speed of twenty-five miles an hour with aëroplanes, he estimates that 5.87 horse-power would be required per ton of weight. The inclination of the supporting surface should be between one degree and two degrees to the horizon. The great difficulty, Mr. Chanute states, is that of obtaining a light enough motor. The weight should not exceed fifty pounds per horse-power; and the lightest steam-engine he is acquainted with, especially built for aërial navigation, weighed thirteen pounds per horse-power. Mr. Brotherhood has obtained a horse-power with but little over one pound of weight in his three-cylindered engine used in Whitehead torpedoes. These engines work with compressed air.

— We learn from the *Journal of the Society of Arts*, London, that sawdust and shavings, practically waste substances, are turned to account by M. Calmant of Paris for the production of a finely divided vegetable charcoal, which is intended to be applied for the removal of unpleasant flavor in ordinary French wine, otherwise unsalable as wine, although suitable for distillation. The charcoal is also available as a filtering medium, especially in distilleries, where it is said to be capable of filtering forty times its volume of alcohol; whereas the vegetable charcoal of commerce, gradually becoming scarcer and dearer, and which requires grinding and often recarbonization, will only filter about three times its volume. If not already separate, the sawdust of hard and soft woods must be separated, because the former requires a heat of 700° C., whereas 500° C. suffice for carbonizing the latter. Carbonization, which lasts about an hour, is effected in fire-clay, plumbago, or cast-iron retorts, of about 600 cubic inches capacity; but previous to this process, the sawdust must be sifted, first through a coarse screen to remove splinters and extraneous matter, and then through a fine sieve, which only permits passage of the actual wood-dust with the adherent calcareous matter. The product of carbonization must again be sifted to get rid of this calcareous matter which has become detached during the process, when it will, if the operation has been carefully performed, resist the action of hydrochloric acid. Shavings of either hard or soft woods, also kept separate, must be subjected to preliminary treatment (which consists in a beating, to detach the adherent dust, and then a high degree of compression in a hydraulic or other press), when they are carbonized in the same manner as the sawdust, and then ground in a mill to reduce them to the same degree of fineness. Great care must be exercised to prevent the charcoal absorbing moisture from the atmosphere, and with this object it must be enclosed in air-tight recipients until required for use.

SCIENCE:

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THE CHEMICAL SOCIETY'S JUBILEE [1]

AT the meeting in celebration of the jubilee of the Chemical Society, held in the theatre of the London University on Tuesday, Feb. 24, 1891, the proceedings were opened by the following address from the president, Dr. W. J. Russell: —

We meet to-day to celebrate the fifty years' existence of our society, — a time, if measured by the progress which our science has made, equal to centuries of former ages, but which in years is so brief a space that we have, I am happy to say, with us to-day some of those who were present, and who took an active part in the foundation of the society; and I need hardly say with how much interest we shall listen to their reminiscences of the time and circumstances connected with the birth of our society.

I would, by way of introduction, say a few words first with regard to our society, and afterwards with regard to the state of chemistry in England when our society was founded. We boast, and I believe rightly, that our society holds the distinguished position of being the first which was formed solely for the study of chemistry. Chemistry and physics, twin sisters, had hitherto always dwelt together; and many were the societies, both in this country and abroad, devoted to their joint study and development.

In London there was the Royal Society, which had hitherto received the most important chemical papers; there was also the Society of Arts, which is a hundred and ten years, and the British Association, which is ten years, senior of our society. In Manchester the Literary and Philosophical Society had been founded and actively at work since 1781; and we admit that our neighbors at Burlington House, the Astronomical, Antiquarian, Linnean, and Geological Societies, are all our seniors. They had a distinct individuality and literature of their own, which called them into existence some forty to eighty years before the commencement of our society. Small private chemical societies, no doubt, existed: they are the natural forerunners of a large society, and become merged into it. The Chemical Section of the British Association, which is an ephemeral and peripatetic chemical society, had existed from the founding of that body. If we turn to other countries, we find that, much as our science had been cultivated on the continent, it did not until later times engross a whole society to itself; the French Chemical Society hot having been formed until 1857, and the now great Berlin Chemical Society not until 1868. Our interest, however, at the moment is rather in the growth of chemistry in this country than in what occurred elsewhere.

To-day we may learn how it came about that the first chemical society was established in England. I may, however, state that the reason for our meeting depends on the official record that on Feb. 23, 1841, twenty-five gentlemen "interested in the prosecution of chemistry" met together at the Society of Arts to consider whether it be expedient to form a chemical society. Of the twenty-five who then met, I am happy to say three are present, — Sir W. Grove, Sir L. Playfair, and Mr. Heisch; and Mr. J. Cock is another of this band who is still alive, but is not present.

These twenty-five gentlemen appear without dissent to have come to the conclusion that it was expedient to form a chemical society, and appointed a committee of fourteen to carry this resolution into effect. So expeditious were they in their work, that in little more than a month the first general meeting was held, and the provisional committee brought forward a report embodying a plan for the constitution and government of the society; and this plan remains essentially the same, save in one point, to the present day. I refer to the formation of a museum of chemical specimens. This project was abandoned some years ago. It is worth recording that at this first general meeting Thomas Graham was elected president; Messrs. W. T. Brande, J. T. Cooper, J. F. Daniell, R. Phillips, vice-presidents; Mr. Arthur Aikin, treasurer; Messrs. Robert Warington, E. F. Teschemacher, secretaries; council, Dr. T. Clarke, Rev. J. Cumming, Dr. C. Daubeny, Messrs. T. Everitt, T. Griffiths, W. R. Grove, H. Hennell, G. Lowe, W. H. Miller, W. H. Pepys, R. Porrett, Dr. G. O. Rees; also that the society then numbered seventy-seven members. We hail Sir W. Grove as being the most active member who is still among us in founding our society, for he was a member of the first council, was present at the first meeting, and was a member of the provisional committee. I must here add to the official record, for it does not tell us how these twenty-five gentlemen "interested in the prosecution of chemistry" were collected together at one time and place. Obviously some special force was required to build up this complicated molecule. That special force was embodied in and exercised by Robert Warington. By his activity and energy he brought about this meeting; and we can imagine how difficult and troublesome a work it probably was, how some of these gentlemen had to be instigated to action, others repressed, some convinced that the aim was desirable, others that it was feasible. But whatever the difficulties were, Mr. Warington succeeded, and to him we are indebted for the formation of our society. Although he has passed away, he is ably represented here to-day by his son. The love for the Chemical Society has proved to be hereditary. Mr. Warington of to-day is a most active and valued member, is one of our vice-presidents, and, as our programme shows, is about to present to us records connected with the early history of our society which are of great interest now, and will become of increasing value as time goes on.

I turn now at once from these matters immediately connected with our society to the consideration of what was being done in chemistry in this country fifty years ago. At that time public laboratories for the systematic teaching of chemistry did not exist in London. The number of real students of chemistry in this country was very small. They

[1] From Nature.

were looked upon by their friends as being eccentric young men, who probably would never do any good for themselves; and these few students found practical instruction in the private laboratories of some of the London teachers.

The practical teaching of chemistry appears to have been undertaken in Scotland much earlier than in England, for Dr. D. B. Reid held practical classes at the University of Edinburgh as early as 1832. Graham came to London from Glasgow in 1837, and until the opening of the Birkbeck Laboratory, in 1846, he had from time to time private students working in his laboratory. And so with the other teachers, who all had private or articled pupils. I doubt whether the pupils received much systematic instruction; but they gained an insight into laboratory work, saw how apparatus was put together, and how analyses were made. We have indeed to wait some years before public laboratories are established, for not till 1845 is the College of Chemistry opened: and this appears to have been really the first public laboratory in London; and its object, as stated by its founders, is "to establish a practical school of chemistry in England." About the same time both University and King's College established laboratories. The council of our society recognized the importance of these occurrences: for in the annual report in 1847 they say, "Although an event not immediately connected with the society, the council has much pleasure in commemorating the late successful establishment in London of chemical laboratories expressly designed to further the prosecution of original research. The new laboratories of the College of Chemistry, and of the two older Colleges of the London University, now offer facilities for practical instruction and research not surpassed, we believe, in any foreign school."

While speaking of laboratories in London, I should, however, mention that the Pharmaceutal Society established a laboratory especially, if not exclusively, for its own students, as early as 1843.

It was not till several years later, till 1850 and 1851, that the medical schools in London established classes of practical chemistry.

If we consult the scientific journals of the time immediately preceding the formation of our society, we find it was by no means a period of chemical activity in this country, but rather a dull time, given more to the study and slow development of the science than to discovery. Methods of analysis, both organic and inorganic, had been much improved; and the dominant idea was the determination of the empirical composition of bodies, and the preparation of new compounds, whose existence was predicted by a study of Dalton's "Atomic Theory." Graham, Kane, and Johnson of Durham were the leaders in scientific chemistry, and the authors of the most important chemical papers of the time. Graham had very lately published his notable paper on the constitution of salts,—a paper which gained for him, some years after its publication, a royal medal. Kane was an active worker and a bold theorist, and at this time his reputation was much increased by a paper on the chemical history of archil and litmus. Johnson was also a most active chemist. His contributions relate to many branches of the science, but especially to the chemical composition of minerals. In 1841, however, he was engaged on a long series of papers on the constitution of resins. He will probably be best known and remembered as an agricultural chemist. Faraday we can hardly claim as a chemist at this time, for he was then rapidly publishing his long series of experimental researches in electricity. While speaking of electricity, I should state that it was in 1840 that Smee described his battery, and the Society of Arts awarded him a gold medal for it. An important branch of our science was, however, coming into existence,—a branch which has found many and successful investigators in this country. I mean photography. It was in 1840 that Herschel published in the "Philosophical Transactions" his elaborate paper on the chemical action of the rays of the solar spectrum,—a paper in which he recognizes a new prismatic color beyond the violet, and chemical activity in the spectrum beyong the red, and, besides discussing many other matters, establishes his previously discovered hyposulphite of soda as the best agent for the fixing of sun-pictures. Fox-Talbot had previously given an account of photogenic drawing, and claims that as far back as 1835 he took pictures of his house by means of a camera and chloride-of-silver paper; but it is not till 1838 that the secretary of the Royal Society extracts from him a clear account of the details of his process, and it is in 1841 that he is granted a patent for improvements in obtaining pictures or representations of objects. Again, in the following year, Herschel published another paper of much importance. I can here only mention how actively this line of research was prosecuted by Robert Hunt; how many, ingenious, and interesting were the experiments he made; and how valuable was the account he afterwards gave of this subject in his "Researches on Light." Thus the work done in this branch of chemistry at the time of which I am speaking is certainly noteworthy, probably more so than in other branches of chemistry. In fact, of other advances in chemistry there is little to record; but I may mention that Clarke's process for determining the hardness of water also holds its jubilee this year, for it was in 1841 that a patent was granted to Dr. T. Clarke for a new mode of rendering certain waters less impure and less hard.

Not a single chemical paper appears in the "Philosophical Transactions" for 1841; but there are two papers which were much discussed at this time, and, although they were readily shown to be erroneous, still are interesting as indicating the chemical ideas of the day. One is by Robert Rigg, who is carrying on an experimental inquiry on fermentation, and is termed "Additional Experiments on the Formation of Alkaline and Earthy Bodies by Chemical Action when Carbonic Acid is Present." It is published in the "Proceedings of the Royal Society." The other is a paper by Dr. S. M. Brown, entitled "The Conversion of Carbon into Silicon," and is published in the "Transactions of the Royal Society of Edinburgh."

With regard to the first paper, Mr. Rigg believes that he has demonstrated, that, when fermentation takes place, a great and direct increase in alkaline and earthy salts, viz., of potass, soda, and lime, occurs,—an increase varying from fifteen to nineteen times the original amount. Denham Smith, who has only very lately passed away, showed that the theory simply rested on inaccurate experiment.

The object of the other paper is to demonstrate, that, on heating paracyanogen, nitrogen is given off, and a residue of silicon remains. Dr. Brett and Mr. Denham Smith controverted this, and, in a paper in the *Philosophical Magazine*, proved that the supposed silicon was simply carbon in a very incombustible state. So important an experiment was this alleged conversion of carbon into silicon considered to be at the time of its publication, that it attracted Liebig's attention; and in a letter to Dr. Playfair, which was communicated to the meeting of the British Association at Plymouth in 1841, Liebig says he has repeated Dr. Brown's experiment on the

production of silicon from paracyanogen, but has not been able to confirm one of his results.

As far as pure chemistry is concerned, it was rather a time of repose. The beginning of the century had been a brilliant time for chemistry in England. Dalton had published his atomic theory; Davy had decomposed potash and soda, and had demonstrated that chlorine was an element; and Cavendish and Wollaston were then still at work. In fact, the most important discoveries of that time were made in this country; but I fancy that during this later period a feeling grew up that the age of brilliant discoveries was over, and that, apart from the preparation of a few new compounds, the essential work of the time was analysis and the determination of the percentage composition of bodies. Still much quiet study of the science was going on, as is indicated by the considerable demand which existed for good text-books. Henry's, Turner's, Kane's, and Graham's "Chemistry,"— all these, without mentioning others, went through numerous editions, and played a very important part in the spread of chemical knowledge in our country.

Another text-book, which is interesting as showing how little organic chemistry was studied in this country, is Dr. Thomas Thompson's work on "Vegetable Cemistry." Dr. Thompson states in his preface that the object of the book is to lay before the British public a pretty full view of the present state of the chemistry of vegetable bodies; and, further, he says "that the ultimate analyses he gives have, with very few exceptions, been made upon the continent, and principally in Germany and France. British chemists have hardly entered on the investigation." Evidently, then, at this time organic chemistry had been but little studied in this country.

When our society was founded, Thomas Graham was certainly the most distinguished chemist in England. He came to London in 1837 as professor of chemistry at University College, succeeding Edward Turner. The work he had already accomplished was of a high order, and he was now occupied in writing his book, which appeared in 1842

The book was an admirable account of the chemistry of the time. It contained a well-arranged and clearly written introduction, describing the principles and latest discoveries in those branches of physics which bear most directly on chemistry. There was also an able and succinct account, probably the best which had then appeared in this country, of organic chemistry; and with regard to physiological chemistry, he states in the preface that he gives a "condensed view of the new discoveries in this department, which now enters for the first time into a systematic work on chemistry."

There are, however, indications that a knowledge of the discoveries and discussions going on on the continent only slowly reached this country. This is strongly insisted on in the *Philosophical Magazine* of 1841, by Messrs. Francis and Croft, who state that "but little of what is done abroad, especially in Germany, seems to find its way into England, or at least until the lapse of some years." In proof of this statement, they mention results lately published by Dr. Apjohn, Professor Johnston, and Dr. Golding Bird, all of which had been known on the continent some time previously. A valuable series of communications, described as "Notes of the Labours of Continental Chemists," is afterwards communicated by these chemists to the *Philosophical Magazine*, and continued for several years.

The visit of Liebig in 1837, when he attended the meeting of the British Association at Liverpool, must have given some stimulus to the study of organic chemistry in England; and we find that he undertook to report to the British Association on isomeric bodies, and also on organic chemistry; and this great undertaking resulted in his two works, — the one "Chemistry, in its Application to Agriculture and Physiology;" and the other, "Chemistry, in its Applications to Physiology and Pathology." Both books were dedicated to the British Association, the first appearing in 1840, the second in 1842. It is very difficult for us now to realize the importance of these works, and properly to appreciate not only the large amount of new knowledge which they contained, but, what is of still greater importance, the novelty of treating such subjects in a truly scientific spirit. Gradually this treatment of the subjects became understood and appreciated, and people took a higher view of chemistry, and regarded it as a true science, and not merely as a study which might lead to useful results.

If, then, it be true that chemistry at this epoch was not rapidly progressing in this country, we naturally ask how it came about that our society from its very foundation was so successful. The explanation is not difficult to find, nor doubtful; for we have only to turn from our own country to the continent and learn what is happening there. Liebig is at Giessen; Wöhler at Göttingen; Bunsen at Marburg; Dumas, Laurent, Gerhardt, and a host of distinguished and active chemists, in France; and at this time even Berzelius and Gay Lussac are alive. Liebig, with his wonderful energy and ability, was powerfully advocating the theory of compound radicles, and was extending in every direction our knowledge of organic chemistry, and inspiring all who came within the range of his influence with a love for investigation. Dumas, at the same time, both as a chemist and a finished advocate, was advancing his views on substitution and chemical types. Laurent, and afterwards Gerhardt, were with conspicuous ability showing how these theories were to be extended and modified so as to assume a form which has, even with the lapse of time, been but little altered. Thus on the continent it was a time of wonderful activity. Chemistry was every day becoming more of a true science, and the constitution as well as the composition of bodies was actively being discussed and investigated. This activity on the continent took time to reach and really affect us here. The older chemists thought the new theories were visionary and unsound, the simple theories of their younger days were being swept away, and only slowly did they realize the meaning of the newer form of their science; but the wave of progress could not be stopped, and in this country we had been ripening for the change. Clearly the immediate cause of this sudden increase of chemical activity in England was Liebig. His famous school had now been established for several years at Giessen; and if the older men in this country did not altogether put their trust in him, the younger men, breaking through all restraint, flocked from this country to his laboratory, there to become indoctrinated with his enthusiasm for the study of chemistry, and to learn how scientific investigation was to be carried on. At this epoch our society was founded; and our journal shows how successful Liebig's teaching was, how a new spirit was instilled into English chemistry, and how much valuable work his students did. Our society gave them a ready means of publishing their discoveries, and a meeting-place for discussion and mutual interchange of ideas. Thus do I explain the success which from the first has attended on our society; and, having now led you to this point, I stop, for my part was merely to speak the prologue, and I leave the story of the society's development to others.

THE FEEDING OF FOWLS.[1]

ON July 2, 1889, ten Plymouth Rock hens, one year old, and as nearly as possible of uniform size, were selected from a flock of thirty-five. At the same time ten chickens, hatched from the same hens mated with a Plymouth Rock cock, were similarly chosen. The chickens were about six weeks old, healthy and vigorous, and of nearly the same size. Up to the time of purchase, both hens and chickens had full run of the farm. The hens foraged for themselves, and were given no food. The chickens had been fed corn-meal dough, sour milk, and table-scraps.

A preliminary feeding-trial was continued for twenty-five days, during which time both hens and chickens were confined all together in a fairly well lighted and ventilated room, and fed a great variety of food, in order that all should go into the feeding-trial as nearly as possible in the same condition. During this preliminary feeding, both hens and chickens increased in live weight, — the ten hens from a total of 44 pounds 12 ounces to 47 pounds 1.5 ounces, or 3.75 ounces each, laying 93 eggs; the chickens, from a total of 9 pounds 15 ounces to 18 pounds, or 12.9 ounces each.

Food, shells, and water were kept constantly before the fowls. Basins which contained the food and water were kept within a box constructed of lath, so arranged that the fowls could reach between the slats and procure food and drink without wasting or soiling.

July 26 the hens and chickens were each separated into two lots of five each, as follows: hens, nitrogenous ration, weighed 23 pounds 8.5 ounces; hens, carbonaceous ration, weighed 23 pounds 9 ounces; chickens, nitrogenous ration, weighed 8 pounds 15 ounces; chickens, carbonaceous ration, weighed 9 pounds 1 ounce.

The four lots were placed in separate pens, where they remained during the entire experiment, which lasted one hundred and twenty-five days. They were fed and watered once daily, and an account kept of the food eaten and water drank. At each feeding the food and water remaining was weighed back, and deducted from the amount charged at the previous feeding.

The hens and chickens fed a nitrogenous ration were given daily all they would eat of the following mixture, — one-third part wheat-bran, one-third part wheat-shorts, one-third part cottonseed-meal, two parts skimmed milk, — and will be designated Lot I.

The hens and chickens fed a carbonaceous ration were given daily all they would eat of a ration of cracked maize and maize dough, and will be designated Lot II.

Both groups were given a small amount of green clover as long as it lasted, and afterward cabbage.

For convenience the experiment was divided into five periods of twenty-five days.

During the first period all the fowls seemed in good health except the carbonaceous fed chicks. They, during this as in all succeeding periods, were restless and peevish, always moping or hunting for something to eat, though their trough was filled. When fed, they would greedily take a few mouthfuls, and then, with their hunger still unappeased, would leave the dish. They always ate ravenously the green food which was given them, as did the hens and chickens of Lot I. The hens of Lot II., on the contrary, seemed quite willing to squat about the pen and subsist on the maize diet, and, strangely enough, cared little for green food. The clear maize diet was accompanied by such ill effects, that the chickens of each lot, after the first period, were given daily each one-fourth ounce of wheat, and the hens each one ounce. The wheat was increased during the fourth and fifth periods, in the case of the chickens, to one ounce each. During the second period, one of the chickens fed nitrogenous food, and during the third period another of the same lot, were taken ill and removed from the experiment. Both seemed to be suffering from impacted crops, as the stomach and gizzard in each case were found to be empty.

The fact that the sick chickens disliked the nitrogenous ration, and that since the first period the amount of food eaten by the hens and chickens of Lot I. had continually decreased, led to the belief that their food might be too nitrogenous; and as, during the last days of the third period, one of the hens in Lot I. was also ill, it was decided to discontinue the use of cottonseed-meal, and to use linseed-meal instead. The hen recovered soon after the change in food.

The supply of skim-milk running short in the last two periods, water was used instead in mixing the ration of the lots fed nitrogenous food.

At the beginning of the fifth period one-half of the linseed-meal in the ration of Lot I. was removed, and cottonseed-meal substituted. This combination seemed a happy one, for on this ration both hens and chickens made large gains.

At the end of the experiment little difference could be seen in the hens of the two groups; but the two lots of chickens were in striking contrast. While the chickens fed on nitrogenous food were large, plump, healthy, active, and well feathered, the chickens fed on a carbonaceous ration were in general much smaller, sickly, and in several cases almost destitute of feathers. Two of them had perfectly bare backs, and so ravenous were they for flesh and blood that they began eating one another.

The inability of the chickens fed on a carbonaceous diet to throw out new feathers, and the ability of the chickens fed on a nitrogenous diet to grow an enormous coat of feathers, is a splendid illustration of the effect of the composition of the food in supplying certain requirements of animal growth. It was plain to see that maize, even when assisted by a small amount of wheat and green clover, could not supply sufficient nitrogen for the growth of feathers.

While both lots of hens lost weight during the experiment, the loss was slightly greater with those fed nitrogenous food, but these produced by far the most eggs.

The chickens fed on nitrogenous food just about doubled in weight, while those fed on carbonaceous food only added about one-third to their weight.

During the first week the carbonaceous fed hens laid three eggs, while the others laid two. The two groups were therefore practically evenly divided at the start as to the condition of the laying stage. At the end of the first period the nitrogenous fed hens had laid forty-three eggs, and the carbonaceous fed hens had laid twenty. During the next twenty-five days the former laid thirty, and the latter six. During the third period the former laid six, and the latter not any. From this time on, no eggs were received from either group. The decline in egg-production was probably due in large part to the fact that the hens began to moult during the second period, and continued to do so during the rest of the experiment.

The eggs laid by the nitrogenous fed hens were of small size, having a disagreeable flavor and smell, watery albumen, an especially small, dark-colored yolk with a tender vitelline membrane, which turned black after being kept several weeks; while the eggs of the carbonaceous fed hens were large, of fine flavor, of natural smell, large normal albumen, an especially large rich yellow yolk, with strong vitelline membrane, which was perfectly preserved after being kept for weeks in the same brine with the other eggs.

Samples of the eggs from each lot of fowls were privately marked, and sold to a boarding-house where the cook did not know that the eggs were undergoing a test. On meeting the cook several days later, the following words were heard: "Do you expect me to cook such eggs as these? About every other one is spoiled."

On examination of the ovaries after slaughtering, it was found that in the case of one of the carbonaceous fed hens the ovules were in a more advanced stage, but, on the whole, the nitrogenous fed hens were much nearer the laying period. With this single exception, the cluster of ovules in the carbonaceous fed hens were uniformly small. Neither group would have laid under any probability for several weeks. It would seem from these facts, together with the fact that during the experiment the nitroge-

[1] Condensed from a thesis prepared for the degree of bachelor of science in agriculture, by James Edward Rice, a graduate of the class of 1890 of the College of Agriculture of Cornell University.

nous fed hens laid more than three times as many eggs, that a nitrogenous ration stimulates egg-production.

On Nov. 27 the fowls were slaughtered. Each fowl was weighed, wrapped in a bag to prevent floundering, and killed by severing an artery in the roof of the mouth. The blood was caught in a glass jar. The fowls were then picked and the feathers weighed, after which the body was laid open longitudinally by cutting alongside the sternum and through the backbone. When all had been thus prepared, they were hung up in groups to be photographed, but the photographs were quite unsatisfactory so far as showing the relative proportions of fat and lean.

One half of each fowl was tested by cooking for flavor, succulence, and tenderness: the other half was carefully prepared for chemical analysis by separating the meat from the bones. The flesh was thoroughly mixed and run through a sausage-cutter, mixed again, and the process repeated three times. From different parts of this mixture a large sample was taken, from which the chemist took his samples for analysis. The right tibia of each fowl was tested for strength by placing it across two parallel bars and suspending a wire on its centre on which were placed small weights until the bone gave way.

Dressed Weight, Internal Organs, etc.

	HENS.		CHICKENS.	
	Lot I. Nitrogenous.	Lot II. Carbonaceous.	Lot I. Nitrogenous.	Lot II. Carbonaceous.
Live weight, pounds	21.31	22.00	17.89	12.63
Dressed weight, pounds	14.86	15.09	12.01	8.89
Dressed weight per hundredweight, pounds	69 70	68.60	67.10	70.50
Weight of blood, pounds	.75	.66	.55	.34
Weight of feathers, pounds	1.41	1 25	1.28	.66
Weight of intestinal fat, pounds	.59	1.98	.34	.66
Weight of offal, pounds	3.70	3.02	3.62	2.08
Weight of bones, pounds	3.47	3.63	3.18	2.69
Weight of flesh, pounds	11.39	11.47	8.93	6.20

The breaking strain of the right tibia was as follows for the hens and chickens of the various lots: —

Average, hens, nitrogenous 48.16
Average, hens, carbonaceous 51.74
Average, chickens, nitrogenous 46.64
Average, chickens, carbonaceous 31.18

There was little difference in the strength of the bones of the hens, undoubtedly because the bones were mature before the feeding began, and were little affected by the feeding. We find, however, that the bones of the chickens fed on nitrogenous food were almost fifty per cent (49.6) stronger than those fed carbonaceous food.

The flesh of each group was submitted to a number of persons for a cooking test, and the almost unanimous verdict was that the flesh of the fowls fed a nitrogenous ration was darker colored, more succulent, more tender, and better flavored, though on this last there was some difference of opinion.

So far as it is warrantable to draw any conclusions from a single experiment of this kind, it would seem that chickens fed on an exclusive corn diet will not make a satisfactory development, particularly of feathers; that the bones of chickens fed upon a nitrogenous ration are fifty per cent stronger than those fed upon a carbonaceous ration; that hens fed on a nitrogenous ration lay many more eggs, but of smaller size and poorer quality, than those fed exclusively on corn; that hens fed on corn, while not suffering in general health, become sluggish, deposit large masses of fat on the internal organs, and lay a few eggs of large size and excellent quality; and that the flesh of nitrogenous fed fowls contains more albuminoids and less fat than those fed on a carbonaceous ration, and is darker colored, juicier, and tenderer.

FEEDING STEERS OF DIFFERENT BREEDS.

IN Bulletin No. 69 of the Michigan Agricultural Experiment Station Mr. Eugene Davenport, agriculturist of the station, remarks that it has long been known that other influences than food operated decidedly to affect the gains of a feeding animal. The individual variation is great, often if not always easy to foresee, but impossible to estimate, hence the benefit of selection; and every feeder knows that as much depends upon the selection of the bunch of feeders as upon their after-care.

The question has arisen in the minds of men, whether or not, by the various standards of selection employed in the establishment of breeds, any important differences have resulted; and whether or not, properly speaking, there are such things as breed differences aside from form, color, etc.; and, if so, what are their character and extent? Are they sufficient to distinguish one breed above another?

This question was made the basis of two extended feeding experiments by the Michigan Station with steers of different breeds. The first is reported in full in Bulletin No. 44, and the second forms the subject of Bulletin No. 69.

Though primarily conducted as an experiment between the breeds, Mr. Davenport prefers to present the records and data independent of that question, — to discuss it in other bearings as well, and discover, if possible, what other circumstances may have exerted influences upon the gains, retaining till the close of the discussion the question of the breeds.

The influence of different kinds of feed-stuffs has not entered into this experiment. The idea has been to feed them alike, using a mixed grain diet, and giving some variety both in grain and coarse fodder, and to adjust the amount of both at all times to the appetite of the individual animal. The rations of all the steers have been at all times precisely alike, except as to amount and some slight variations which they established themselves between grain and coarse fodder.

Every opportunity possible has been afforded, regardless of expense, for individual differences and breed peculiarities to appear.

Neither this nor any similar experiment is absoutely just to all the breeds. The conditions have been made alike for all, except as to the amount of food each chose to take. But like conditions cannot be taken as being equally favorable to all. The framing of an experiment which should afford each its best conditions would include those so dissimilar as to make the results not capable of comparison. Likely this is as well as could be done, though it certainly affords conditions more nearly natural to some than to others. There is no doubt, that if they had been kept in open yards, with a higher proportion of coarse fodder, the results would have been greatly different, both absolutely and relatively. The whole experiment may be taken as one employing a heavy grain ration, for the bunch consumed as many pounds of grain as of coarse fodder if the latter had been equally dry.

The plan was to secure as nearly typical specimens of the breeds as possible. There were originally two each of the five breeds, Galloway, Holstein, Hereford, Short-Horn, and Devon, but accidents deprived the station of one of the Short Horns and one of the Devons.

It is not thought that either breed suffered in the loss. It is to be regretted, but it is not always possible to carry ten animals for two years and a half and all remain in every way normal. This is mentioned lest the experiment be criticised for furnishing only one specimen of these two breeds. This loss is to be regretted, for even the two is too small a number to estimate their personal equation; and not till after that is done can any difference in breeds be fully established.

The grain ration was made up of corn and oats (either whole or

ground), with bran and some preparation of oil-meal. The proportions varied from time to time, but was always the same for all the animals. No molasses was used, nor condiments of any sort.

The coarse fodder was principally mixed hay (timothy and clover), relieved by roots (mangels, turnips, etc.), corn-ensilage, cut grass or corn, and in the early part by pasture. During the first summer they were on pasture a large part of the time for about four months, too long for their best good. The last summer they were out from May 17 to June 6, and rested from grain. This resulted in a temporary loss of weight, but a real advantage to the steers.

The results of this experiment seem strongly to confirm the following: —

1. The amount of food consumed is no index of the amount of gain it will produce; that is, to its profitable use and conversion into meat.

2. Neither is the total gain secured, nor the rate of gain, a sure guide to the economical use of food by the animal.

3. Large gains are not necessarily economical ones, nor medium ones necessarily costly.

4. Age is the all-controlling circumstance that decides the rate of gain. The ration necessary to sustain the gain increases with age in about the same proportion as the weight of the animal, but the gain remains absolutely about the same.

5. That "baby beef" is not inconsistent with high quality.

6. That nervousness is not necessarily a sign of a bad feeder.

7. That great development in size is not a necessary condition to profitable feeding nor to quality.

8. That the "type" of an animal has much to do with his ability to use food to good advantage in the production of meat. In this sense there is a distinction and a difference between the breeds for beef purposes.

9. Those nearest the "dairy type" made less gain to the food consumed, and it consisted more largely of fat on and about the internal organs. This type was also characterized by coarser extremities; a longer, flatter rib; more shrinkage of meat in cooling; and a higher percentage of cheap parts.

10. As between the beef breeds, Mr. Davenport thinks no one can here suggest marked differences that cannot be sufficiently explained on other grounds. As in all experiments of this kind, greater differences are noticeable within the breeds than between them. The two Herefords are in this experiment nearly at extremes in every thing but type, and in that respect as far apart as is allowable among Herefords. Aside from the Holsteins, no two animals of the lot differed more than did the two Herefords. Very close upon them came the two Galloways, with marked differences in build.

11. Knowing these animals as he did, Mr. Davenport thinks he may safely say, that as they, irrespective of breed, approached a certain stocky, blocky form, designated as the "meat type," in the same degree they proved good feeders and economical consumers of food within a reasonable age. On the other hand, as they approached the coarser or more loosely built organization, betraying a circulation more largely internal and less diffused, in about the same proportions were they less profitable consumers of food for meat purposes, and turned out a less desirable carcass for the block. If this be true, it is a question of type rather than of breed; and that breed that affords the largest proportion in members of this type is, all things considered, the best, if any one thinks he knows which breed or breeds that may be.

In saying this, Mr. Davenport believes that he only follows the teachings of this and all other experiments. Nor does it work any injustice to other types selected for and excelling in other special lines. All will make some beef. Only a few will make the best or the cheapest. The strong teaching in this is, that moderate gains are not inconsistent with profit, nor lack of age inconsistent with quality.

An experiment of this kind is attended with much expense and labor. Many a careful thought and laborious hour go to secure what passes into a few tables. If only it shall assist a little in the establishment of knowledge and of truth, and not at all in fostering an error, then every one will be well paid.

OUTLINE OF THE HISTORY OF COMMERCIAL FERTILIZERS.[1]

THE history of commercial fertilizers practically dates back to the time when bones were first applied to the soil, and their value as a fertilizer was recognized. Fertilizing with bones was first practised in England. Probably the first instance of their extensive application was in the case of the farmers living near Sheffield, England, who applied to the land the bone and ivory clippings which were waste products of the knife and button factories of Sheffield. These clippings amounted to about eight hundred tons a year, and were regarded, until about a century ago, as a nuisance, the disposal of which was a serious problem to the manufacturers.

In 1774 the agricultural use of bones was first publicly recommended by Hunter, and successful experiments were made with bone-dust.

About 1814, Alexander von Humboldt called public attention to the use of guano as a fertilizer, which he had seen used by the natives of Peru.

About 1817 the first super-phosphate is believed to have been made by Sir James Murray.

It was not until after 1820 that the use of phosphates assumed any great commercial or agricultural importance, and not even then was it appreciated what gave bones their value as fertilizers.

About 1830, Peruvian guano began to be imported into Europe as a fertilizer, and, a few years after, into the United States, especially at the South.

About 1840, Liebig published the results of his researches, and suggested that plants must obtain materials for their growth from the soil as well as from the air and water, which alone were previously supposed to furnish plant-food, and hence that the proper life of a plant can be benefited by furnishing those elements that are necessary. It was shown that the phosphate of lime in bones gave them their value, and that by dissolving bones with sulphuric acid they were made much more effective. The demand for bones then outran the supply. Other sources were looked for, and in 1843 a new source of phosphate of lime was found in Spain, consisting of a rock which contained considerable amounts of phosphoric acid. On trial, this rock was found to be a substitute for bone.

In the United States, farmers first used bones about 1790. The first bone-mill was built about 1830, and super-phosphates were first used in 1851. The discovery of the so-called South Carolina rock was a great boon to those using commercial fertilizers, as this was found to take the place of bones.

The investigations based upon Liebig's theory showed that other elements in addition to phosphorus must be used to secure the best results, and gradually commercial fertilizers containing other elements came to be manufactured and offered for sale.

LETTERS TO THE EDITOR.

Ohio State University.

BY the recent passage of the Hysell Bill in the Ohio Legislature, which levies a tax of one-twentieth of a mill on every dollar of taxable property in the State, some attention has been turned toward this institution.

The institution was founded in 1862. At that time the State received from the United States 630,000 acres of land; and now the fund from the sale of this land is nearly $540,000, and yields an income of over $32,000.

The legislature has made liberal appropriations from time to time, but the trustees and faculty have hesitated to lay out very extensive plans, for this support was not entirely sure; but, now that this can be depended upon, plans for increasing the facilities of the institution will be carefully considered. The tax will bring the university $90,000 each year, which, together with what it receives from other sources, places Ohio on her feet in the educational race; and she will soon be in advance of her weaker sisters,

[1] From Bulletin No. 26 of the New York Agricultural Experiment Station.

and, instead of holding twenty-fourth rank in education, she will soon take a place in the front, if not in the lead.

The institution has experienced steady growth ever since it was founded. The number of students has increased, and new buildings have been erected for their accommodation. The last one was built in the fall of 1890, and is devoted exclusively to veterinary medicine and science. The new chemical laboratory, dedicated last month, is constructed according to the latest improved plan, and students have the best opportunities for study in all branches of chemistry. In the botanical laboratory is found specimens of plant-life from many parts of the world, and several herbariums both of our own flora and many plants from other countries.

In the mechanical laboratory is found tools and power for the various branches of mechanical art. The physical and electrical laboratories are supplied with the necessary appliances and apparatus for those studies.

The departments of physiology, geology, and zoölogy are in the main building, and are as well equipped as the former circumstances would allow. Students are encouraged, in the natural sciences especially, to original and independent investigation; and to facilitate this, excursions are made to places of especial geological, botanical, or entomological interest. In connection with the university is a biological club, consisting largely of professors and students who are doing advanced work in biology.

Among the many needs of the institution may be mentioned a hall for military drill, a fire-proof building in which to place the valuable geological and botanical museums and the library, more class-rooms, and better equipment in all departments. Other departments will be added to the institution, whose needs, with those of the present departments, will be well supplied; for the aggregate support is now adequate to a great institution, which Ohio State University is destined to be. E. E. BOGUE.

Columbus, O., April 3.

BOOK-REVIEWS.

Mixed Metals, or Metallic Alloys. By ARTHUR H. HIORNS. London and New York, Macmillan. 12°. $1.50.

IN this serviceable and timely volume Mr. Hiorns not only brings his subject up to date, but deals with it in a manner well adapted to the requirements of students and practical men. In these particulars he has followed the same methods used by him in his previous works in the same line, — "Elementary Metallurgy." "Practical Metallurgy," and "Iron and Steel Manufacture." We wish, though, he had omitted the first clause of his title. "Mixed metals," no matter how common the term may be in the metal trade, cannot fairly be considered as equivalent to "metallic alloys:" in other words, a true alloy is not a mere mixture of metals. Aside from this, there is no fault to find with the book.

Publications received at Editor's Office, March 30–April 4.

CAMMANN, D. M. The Physical Diagnosis of the Diseases of the Heart and Lungs and Thoracic Aneurism. New York, Putnam. 188 p. 16°. $1.25.

DAVIES, T. A. Am I Jew or Gentile? Read and see. New York, E. H. Coffin. 87 p. 16°.

FLUGEL, F. A Universal English-German and German-English Dictionary. Vol. I. Part 1. Braunschweig and New York, Westermann. 192 p. 4°. $1.00.

KNOFLACH, A. A Sound-English Primer. New York, Stechert. 68 p. 12°.

LANKESTER, E. R. Zoological Articles contributed to the "Encyclopædia Britannica," etc Edinburgh, Black; New York, Scribner. 195 p. 4°. $5.00.

MAXWELL, W. H. Advanced Lessons in English Grammar. New York, Cincinnati, and Chicago, Amer. Book Co. 327 p. 12°. 60 cents.

NEWSDEALER'S and Publisher's Bulletin. Vol. I., No. 1. March 2, 1891. New York, Newsdealer's and Publisher's Bull. Pub. Co. 24 p. 4°. $1 per year.

QUACKENBOS, J. D., and others. Appletons' School Physics. New York, Cincinnati, and Chicago, Amer. Book Co. 544 p. 12°. $1.20.

SMITHSONIAN INSTITUTION, Annual Report of the Board of Regents of the, showing the Operations, Expenditures, and Condition of the Institution to July, 1889. Washington, Government. 815 p. 8°.

U. S DEPARTMENT OF AGRICULTURE. Proceedings of the Seventh Annual Convention of the Association of Official Agricultural Chemists held at the U. S. National Museum, Aug. 28, 29, and 30, 1890. Washington, Government. 238 p. 8°.

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AMONG THE PUBLISHERS.

THE American Academy of Political and Social Science has just issued the fourth number of its *Annals* The volume just issued deals with the "Genesis of a Written Constitution," by Professor Morey of Rochester; "Natural Law," by Professor Taylor of Michigan; "Compulsory Voting," by Mr. F. W. Holls of New York; and "The Wealth Concept," by Professor Tuttle of Amherst. Another article treats of economic instruction in Italy, and gives an account of the university system. The proceedings contain a discussion of the Original Package decision by Messrs. Budd and Wintersteen of the Philadelphia bar. In addition to the *Annals*, the American Academy of Political and Social Science issues from time to time supplementary volumes of interest to students of economics and politics. The first of these, the "History of Statistics," by Professor August Meitzen of Berlin, has just appeared.

— Heinemann of London announces a new volume dealing with the much-discussed Marie Bashkirtseff, entitled "The Social Life of Marie Bashkirtseff, being Extracts from her Letters and Journals, illustrated with Drawings and Studies."

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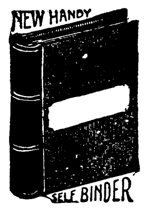

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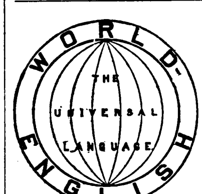

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